IPTC

IPTC - NAA Digital Newsphoto Parameter Record Version 4

Comité International des Télécommunications de Presse

IPTC - NAA DIGITAL NEWSPHOTO PARAMETER RECORD

Version No. 4

October 1997

COPY NO: 9999

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Chapter 1. GENERAL

Section 1.1 Introduction

(a) The Newspaper Association of America (NAA) and the International Press Telecommunications Council (IPTC) have worked jointly to design a universally applicable format for digital image representation. Every effort has been made for this model to be as compatible as possible with ISO and CCITT standards in the fields of application. The joint effort will continue for further development and for amendment when advisable.

(b) The basic document is the IPTC-NAA Information Interchange Model. This document provides a means by which the images of newsphotos or other continuous-tone sources may be transferred within the IPTC-NAA Information Interchange Model. Continuous-tone images are referred to as “images” throughout this document.

Section 1.2 SCOPE

(a) This document defines:

- An application record to provide image parameters.
- The data structure to be used for presentation of information.
- Guidelines for implementation.

(b) This document lies entirely within the scope of the IPTC-NAA Information Interchange Model.

Section 1.3 FIELD OF APPLICATION

This document applies to digitised images distributed by news services to their subscribers or interchanged between other users where appropriate.

Section 1.4 RELATION TO OSI AND NAA-IPTC

(a) This document describes the standardised representation of images for the applications layer (Layer 7) of the ISO Open Systems Interconnection Model (OSI). NOTE: The association to OSI layers may be redefined as OSI connectionless application standards are developed.

(b) Specifically, this document defines a record No. 3 (3:xx) to be included within the IPTC-NAA Information Interchange Model.

Section 1.5 IMPLEMENTATION GUIDELINES

This section is for the software engineer or programmer to use as a guideline when implementing this record.

(a) There is no end-of-DataSet marker. If the receiving system has not detected a new DataSet in the first octet following the end of the preceding data field, as described by the length, the system should assume an error and recover accordingly.

(b) An input program should use the octet counts and not simply search for tag markers as delimiters because the fields can contain binary data that may be of the same value as the tag markers themselves.

(c) A program should ignore a DataSet whose tag number it does not recognise without rejecting the otherwise acceptable data or terminating the program. In this manner extra information that might be provided in new application records will not affect unmodified programs.

(d) A program encountering a DataSet with a repeated tag number should assume that it is “more or another of the same.” If a repeated tag number is encountered for a DataSet defined as non-repeatable, an error condition is assumed and handled without aborting the programme and without aborting data capture, i.e. the data of the first found DataSet should be retained.

(e) In computing pixel size, the height-to-width ratio is obtained by dividing the horizontal relative width in DataSet 3:40 (along the scan line) by the height in DataSet 3:50 (perpendicular to the scan line).

(f) An image is always presented in a positive form.

(g) A “Newsphoto Common Parameter Set” has been defined for various levels of system functionality to enable users of different vendor’s equipment to inter-operate. See Appendix D.

(h) A separate document also is available entitled "Digital Newsphoto Parameter Record Guideline 1" that covers the theory and practice for the transfer of images between systems operating in different domains.

(i) Colour Representation (DataSet 3:60 Octet 0) can have a value of zero when no valid image data is provided. The remaining mandatory DataSet values in record 3 are to be disregarded if DataSet 3:60 Octet 0 contains 0 (zero). Data in the mandatory DataSets is only to be considered as valid when DataSet 3:60 Octet 0 contains a non-zero value.

Section 1.6 RECORD DEVELOPMENT

The introduction of new DataSets (or dropping of old) will occur only after international concurrence.

Chapter 2. TERMS AND DEFINITIONS

For the purpose of this recommendation, the following definitions apply:

Section 1.1 alphabetic, alphabetic character: An alphabetic character is member of a set of characters representing letters of the alphabet.

Example: In the ISO 646 character set, alphabetic characters are between 4/1 and 5/10 (A through Z) and between 6/1 and 7/10 (a through z), all inclusive. Alphabetic characters are shown in this document enclosed in single quotation marks, e.g. 'a', 'T', 'u'.

A series of alphabetic characters is shown in double quotation marks, e.g. "IPTC", "Berlin", "Paris".

Section 1.2 binary number: A series of n data bits b_{n-1}, b_{n-2} ... b_0 where b_{n-1} is the highest order, or most significant bit and b_0 is the lowest order, or least significant bit.

As represented in this document, binary numbers always are expressed from left to right with the left-most bit the most significant bit and the right-most bit the least significant bit. If the binary numbers are formed by multiple octets, the bits forming any octet are presumed to be less significant than those of any octet to the left and more significant than those of any octet to the right. For example, if two octets, numbered left to right as 1 and 2, are taken together as a binary number, octet No. 1 will contain the most significant bits.

Decimal Interpretation:

The bit combinations are identified by notations of the form xxx..., where xxx... is a number in the range 000-infinity. The correspondence between the bits and their value is as follows:

Bits	b_{n-1}, b_{n-2} ... b_0
Weight	2^{n-1}, 2^{n-2} ... 2^0

The least significant bit, i.e. the bit of lowest value always is aligned with the least significant bit of the octet or other data frame containing it.

Section 1.3 CCITT: Comité Consultatif International Télégraphique et Téléphonique. Defunct organisation. Formerly an organisation of telephone and telegraph providers with headquarters in Geneva, Switzerland. Replaced in December 1992 by a division of the International Telecommunications Union (ITU) Standardization Sector.

Section 1.4 caption, rasterised: Scanned caption information which has not been character coded because of language or other restriction.

Section 1.5 character: A member of a set of elements used for the organisation, control or representation of data.

Section 1.6 code table: A table showing the character allocated to each bit combination in a code.

Section 1.7 Co-ordinated Universal Time (UTC): The time scale defined by the Bureau International de l'Heure (International Time Bureau) that forms the basis of a co-ordinated dissemination of standard frequencies and time signals. The mismatch of ordering of characters between the name and initials is intentional.

1, The source of this definition is Recommendation 460-2 of the Consultative Committee on International Radio (CCIR). CCIR has also defined the acronym for Co-ordinated Universal Time as UTC.

2, UTC is often (incorrectly) referred to as Greenwich Mean Time and appropriate signals are regularly broadcast.

Section 1.8 day: A period of time of 24 hours starting at 0000 and ending at 2400 (which is equal to 0000 the following day).

Section 1.9 editorial material: Data contained in the object that represents observations, opinions or analysis of the provider as opposed to statistical data, that simply reports data such as temperatures, sports scores, financial market prices, etc.

Section 1.10 Envelope Record: Record 1:xx of the Information Interchange Model.

Section 1.11 graphic character: A member of a subset of a set of characters. The graphic character subset includes all characters that have visual representation, normally hand-written, printed or displayed, and that has a coded representation consisting of one or more bit combinations. Control codes, space character (ISO 646 2/0) and DEL (ISO 646 7/15) are not graphic characters. The sets of alphabetic and numeric characters are subsets of the set of graphic characters. Graphic characters are shown in this document enclosed in single quotation marks, e.g. '*', 'T', '-'. A series of graphic characters are shown in double quotation marks, e.g. "IPTC-7901", "DÜSSELDORF", "$1.99". Note that the visual representation of a graphic character depends upon the character set invoked at the time of evaluation.

Section 1.12 Information Interchange Model: A joint document developed by the International Press Telecommunications Council and the Newspaper Association of America to present a globally applicable model for all kinds of data.

Section 1.13 image, reduced resolution: A smaller, less detailed image used to preview a high resolution image and save processing and storage space.

Section 1.14 International Press Telecommunications Council (IPTC): An organisation of news agencies, newspapers and other news organisations, with headquarters in Windsor and formed for the establishment of news transmission standards and other activities for the common benefit of its members. (Also known as the Comité International des Télécommunications de Presse.) The address is found in Appendix B.

Section 1.15 International Organization for Standardization (ISO): An international body with headquarters in Geneva, Switzerland, to co-ordinate the work of national bodies such as ANSI, BSI or DIN. Also involved are IEEE, ECMA and the IPTC. ISO is broadly responsible for standards that operate over communications media. The mismatch of ordering of characters between the name and initials is intentional.

Section 1.16 ISO 646: A coded set of characters based upon seven significant bits. ISO 646 has numerous national versions. Unless otherwise specified, all references herein contained are to the International Reference Version.

Section 1.17 ITU: International Telecommunications Union. An organisation of telephone and telegraph providers with headquarters in Geneva, Switzerland. The ITU reports to the United Nations Organisation (UNO). All telecommunications administrations and recognised private common carriers belong to the ITU. The address is found in Appendix B.

Section 1.18 logo: An image associated with the "Credit" (DataSet 2:110) usually to identify the provider of the object.

Section 1.19 minute: A period of time of 60 seconds.

Section 1.20 month, calendar: A period of time resulting from the division of a calendar year in twelve sequential periods of time, each with a specific name and containing a specific number of days.

Section 1.21 NAA: The Newspaper Association of America was created on 1 June 1992 from the American Newspaper Publishers Association (ANPA), the Newspaper Advertising Bureau (NAB), and six other newspaper associations. NAA represents nearly 2000 newspapers in the United States, Canada, and around the world. The address is found in Appendix B.

Section 1.22 Newsphoto Common Parameter Set (NCPS): Specifies a minimal number of DataSets from the Information Interchange Model and Digital Newsphoto Parameter Record with assigned values to ensure that images may be interchanged between complying equipment regardless of whether they support the entire range of DataSets. The selected parameter values are identified in the document text and are summarised in Appendix D.

Section 1.23 numeric, numeric character: The textual representation by means of a specific character set of the binary values 0-9 in decimal notation. Numeric characters are a subset of the set of graphic characters and are the characters '0', '1', '2', '3', '4', '5', '6', '7', '8', '9'. In this document, numeric characters are enclosed in single quotation marks. Series of numeric characters are enclosed in double quotation marks, e.g. "23", "124".

Section 1.24 object: A term to describe the entire data collection of all records, excluding record 1 DataSets concerned with data transmission, for an instance under the Information Interchange Model.

Section 1.25 objectdata: A collection of binary data, such as a photo, news graphic or text, that is the essence of the data to be presented and contained in Record 8.

Section 1.26 octet: A data frame of eight bits identified by b7, b6, b5, b4, b3, b2, b1 and b0 where b7 is the highest order, or most significant bit and b0 is the lowest order, or least significant bit.
Unless otherwise specified, all references to bits of octets herein described are from left to right with the most significant bit on the left and the least significant bit on the right.

Character Definition by Chart Position:

The bit combinations are identified by notations of the form xx/yy, where xx and yy are numbers in the range 00-15 or x/y where x and y are numbers in the range 0-7. The correspondence between the notations of the form xx/yy and the bit combination consisting of the bits b7-b0 are as follows:

	xx				yy			
Bits	b7	b6	b5	b4	b3	b2	b1	b0
Weight	8	4	2	1	8	4	2	1

Decimal Interpretation:

The bit combinations are identified by notation of the form xxx, where xxx is a number in the range 000-255. The correspondence between the notations of the form xxx and the bit combination consisting of the bits b7-b0 are as follows:

Bits	b7	b6	b5	b4	b3	b2	b1	b0
Weight	128	64	32	16	8	4	2	1

Section 1.27 OSI model: OSI stands for Open Systems Interconnection, a term used to describe the agreed international standards by which open systems communicate. The OSI model, jointly defined by CCITT and the ISO, is an architectural model with seven layers. Layers 5 through 7 (Session, Presentation, Application) concern the functions of interworking. The model is described in the ISO 7498 standard.

Section 1.28 second: A basic unit of measurement of time in the International System of Units (SI) as defined in ISO 31-1.

Section 1.29 statistical material: Data contained in the object that represents statistics such as temperatures and climatological conditions, financial market prices, sports scores, etc.

Section 1.30 type, supplement: An object may have associated data. This can be of several types:

1 - reduced resolution image

2 - logo

3 - rasterised caption

Section 1.31 year, calendar: A cyclic period of time in a calendar that is required for one revolution of the earth around the sun.

Chapter 3. DATASET DESCRIPTIONS

	TITLE	DESCRIPTION
3:00	**Record Version**	Mandatory, not repeatable, two octets. A binary number representing the version of the Digital Newsphoto Parameter Record utilised by the provider. Version numbers are assigned by IPTC and NAA. The version of this record is four (4).
3:10	**Picture Number**	Mandatory, not repeatable, 16 octets. The picture number provides a universally unique reference to an image. For example, colour images, when split with colour components into multiple objects, i.e. envelopes, would carry the same Picture Number. **Device Identifier** Octets 0-5 contain a binary number identifying the device that has generated the picture number. Series of identification numbers are provided manufacturers or suppliers by IPTC-NAA upon request (see Appendix C). A unique serial number is applied to each device by its manufacturer-supplier. **Date Identifier** Octets 6-13 contain eight numeric characters using the format CCYYMMDD (century, year, month, day) as defined in ISO 8601 to indicate year, month and day the picture number was generated. Example: “19891009” = 9 Oct 1989 **Numeric Identifier** Octets 14-15 contain a binary number generated each time a

		picture number is created and being unique for the same device and for the date contained in this DataSet. When the originating device (scanner) is not able to generate a relevant picture number, each octet of the picture number should be set to value zero, i.e. a null value.
3:20	**Pixels Per Line**	Mandatory, not repeatable, two octets. Not valid when DataSet 3:60 octet zero (0) is 0 (zero). A binary number representing the number of pixels in a scan line for the component with the highest resolution. NCPS values are 1024 or 2048.
3:30	**Number of Lines**	Mandatory, not repeatable, two octets. Not valid when DataSet 3:60 octet zero (0) is 0 (zero). A binary number representing the number of scan lines comprising the image for the component with the highest resolution. NCPS range is 1 to 2048.

Note: Pixel Size is a relative size expressed as the ratio of 3:40 to 3:50 (3:40/3:50).

3:40	**Pixel Size In Scanning Direction.**	Mandatory, not repeatable, two octets. Not valid when DataSet 3:60 octet zero (0) is 0 (zero). A binary number indicating the number of pixels per unit length in the scanning direction. NCPS value is 1.
3:50	**Pixel Size Perpendicular To Scanning Direction.**	Mandatory, not repeatable, two octets. Not valid when DataSet 3:60 octet zero (0) is 0 (zero). A binary number indicating the number of pixels per unit length perpendicular to the scanning direction. NCPS value is 1.
3:55	**Supplement Type.**	Mandatory when the numeric character in DataSet 2:130 is ‘9’, not repeatable, one octet.

A binary number indicating the image content.

0 -value used if the first octet of DataSet 2:130 <> 9.
1 -reduced resolution image.
2 -logo.
3 -rasterised caption.

3:60 **Colour Representation**

Mandatory, not repeatable, two octets.
Octet 0 is a binary number specifying the number of components.
Octet 1 is a binary number giving the build-up structure of the image.

Allowed values are as follows:

For octet 0
0 - No Image
1 - Monochrome
3 - Three components
4 - Four components

For octet 1
0 - Single frame.
1* - Frame sequential in multiple objects (one component per object)
2** - Frame sequential in one object
3 - Line sequential
4 - Pixel sequential
5 - Special interleaving structure

The special interleaving structures refer to defined methods given in Appendix G according to the value in the sampling structure DataSet 3:90. Allowed combinations are:

0,0
1,0
3,0 - 4,0 ***
3,1 - 3,2 - 3,3 - 3,4 - 3,5
4,1 - 4,2 - 4,3 - 4,4 - 4,5

NCPS values are 1,0 , 3,1 or 3,5.

* Only one component of a colour image in one envelope
** All components of a colour imagein one envelope.
*** In a single-frame colour image, a colour is described with a single sample per pixel.

3:64	**Inter-change Colour Space**	Mandatory if DataSet 3:60 octet zero (0) has a value greater than one, i.e. a multi-component image. Not valid when DataSet 3:60 octet zero (0) is 0 (zero). Not repeatable. One octet. A binary value indicating the colour space in which the pixel values are expressed for each component in the image. Allowed values are: 1 -X,Y,Z CIE colour space (default illuminant D50) 2 -RGB SMPTE 3 -Y,U,V (K) (default illuminant D65) 4 -RGB device dependent 5 -CMY(K) device dependent 6 -L*a*b* (K) CIE colour space (default illuminant D50) 7 -YC_bC_r 8 -sRGB NCPS values are 0, 4 or 7. Other values are reserved for future use. The definition of each colour space is given in Appendix E. The inclusion of K in 3 and 6 is for situations in which a CMYK image has been encoded to enable chrominance sub-sampling without losing the black content. Clearly the K is optional. Suggestions for calibrating 4 and 5 are given in DataSet 3:70 and Appendix F.
3:65	**Colour Sequence**	Mandatory if DataSet 3:60 octet zero (0) has a value greater than one, i.e. a multi-component image AND the value of octet one (1) is 0, 1, 2, 3, or 4, i.e. single frame, frame sequential, line sequential or pixel sequential. Not valid when DataSet 3:60 octet zero (0) is 0 (zero). Not repeatable. One, three or four octets. Each octet contains a binary number that relates to the colour

		component using the identification number assigned to it in the appendix for each colour space. The sequence specifies the sequence of the components as they appear in the objectdata For frame sequential components, only one octet is set to identify the current colour component in the objectdata. Allowed values are: 0 - 1 - 2 - 3 - 4 0 - may be used for “monochrome” or “no image” representations. Other values are reserved. NCPS values are 0,1,2,3 or 123.
3:66	**ICC Input Colour Profile**	Optional, not repeatable, a maximum of 512K octets. Valid when DataSet 3:64 has values 1,2,4,5 or 8. Specifies the International Color Consortium profile for the scanning/source device used to generate the digital image files. This profile can be used to translate the image colour information from the input device colour space into another device's native colour space. The ICC profile is specified in ISO/TC 130/WG2N562.
3:70	**Colour Calibration Matrix Table**	This DataSet is no longer required as its contents have been rendered obsolete by the introduction of DataSet P3:66 (ICC Input Colour Profile). This DataSet will be removed from the next Version of this Standard.
3:80	**Lookup Table**	Optional, not repeatable, maximum 131,072 (128 x 1024) octets. Consists of one, three or four one-dimensional lookup tables (LUT). The LUT relates to the image data in the colour space defined in DataSet 3:64 and specifies the correction to apply to the pixel values before display or printing of the image. Not applicable if the colour space requires converting before display or printing.

Examples of application of such LUT can be: Grey balance, Cast, dot gain compensation ...

The size of the lookup table is defined, for each component, by the number of bits per component given in DataSet 3:135.

The input value is used as the offset into the table.

The table entries are the output values. Each entry should be in one octet if number of bits is lower or equal to 8 and in two octets if number of bits is between 9 and 16. In both cases, the least significant bit should always be aligned on the least significant bit of the least significant octet.

Each LUT is given sequentially in the order specified for the colour sequence given in DataSet 3:65. When a single component is in the objectdata it is accompanied only by its own LUT. If a LUT is required then it must appear with its own component data even if it has the same values as the LUT used for other components.

3:84 **Number of Index Entries**

Mandatory where DataSet 3:60 octet zero (0) has a value greater than one, i.e. a multi-component image AND the value of octet one (1) is 0, i.e. single-frame. Not relevant for other image types, not repeatable, two octets.

A binary number representing the number of index entries in the DataSet 3:85 (Colour Palette).

0 - No Colour Palette contained in DataSet 3:85. A default palette should be used.

1 - 65535 - valid numbers.

3:85 **Colour Palette**

Mandatory if 3:84 exists and is non zero. Not repeatable, up to 524,288 (4 x 65536 x 2) octets.

In a single-frame colour image, a colour is described with a single sample per pixel.

The pixel value is used as an index into the Colour Palette.

The purpose of the Colour Palette is to act as a lookup table mapping the pixel values into the Colour Space defined in 3:64.

The number of index entries is defined in DataSet 3:84.

The number of output values is defined in octet zero of DataSet 3:60.

The number of octets used for each output value is deducted from 3:135.

The colour sequence of the output values is defined in 3:65.

A default palette may be referenced if this DataSet is omitted. A number of default palettes may be held to be selected according to the device identifier component of the Picture Number 3:10.

3:86 **Number of Bits per Sample**

Mandatory if DataSet 3:60 octet zero (0) has a value greater than one, i.e. a multi-component image AND the value of octet one (1) is 0, i.e. single frame. Not relevant for other image types, not repeatable, one octet.

A binary number between 1 and 16 that indicates the number of bits per pixel value used as entries in the Colour Palette. These values are found in the objectdata itself.

Each entry should be in one octet if number of bits is less than or equal to 8 and in two octets if number of bits is between 9 and 16, the least significant bit should always be aligned on the least significant bit of the least significant octet.

3:90 **Sampling Structure**

Mandatory, not repeatable, one octet. Not valid when DataSet 3:60 octet zero (0) is 0 (zero).

A binary number defining the spatial and temporal relationship between pixels.

0 - Orthogonal with the same relative sampling frequencies on each component.

1 - Orthogonal with the sampling frequencies in the ratio of 4:2:2:(4) as described in Appendix G. This structure can only be used with the YUV(K) or LAB(K) colour spaces.

2 - defined within the compression process.

NCPS values are 0 or 2.

Other values are reserved for future use.

3:100 Scanning Direction

Mandatory, not repeatable, one octet. Not valid when DataSet 3:60 octet zero (0) is 0 (zero).

A binary number indicating the correct relative two dimensional order of the pixels in the objectdata. Eight possibilities exist.

0 = left to right, top to bottom.
1 = right to left, top to bottom.
2 = left to right, bottom to top.
3 = right to left, bottom to top.
4 = top to bottom, left to right.
5 = bottom to top, left to right.
6 = top to bottom, right to left.
7 = bottom to top, right to left.

NCPS value is 0.

3:102 Image Rotation

Optional, not repeatable, one octet.

A binary number indicating the clockwise rotation applied to the image for presentation.

Allowed values are:

0 no rotation
1 90 degrees rotation
2 180 degrees rotation
3 270 degrees rotation

3:110	**Data Compression Method**	Mandatory, not repeatable, four octets. Not valid when DataSet 3:60 octet zero (0) is 0 (zero). Octets 0-1 contain a binary number identifying the provider-owner of the algorithm. Octet 2 contains a binary number identifying the type of compression algorithm. Octet 3 contains a binary number identifying the revision number of the algorithm. An identification number is issued by IPTC-NAA to providers-owners of compression algorithms upon request (see Appendix A). The numbers identifying type and revision of algorithms are managed by the providers-owners. A zero (0) value of all octets in this DataSet identifies an uncompressed image. In this case the component values should be in one octet if number of bits is less than or equal to 8 and in two octets if number of bits is between 9 and 16, the least significant bit always being aligned on the least significant bit of the least significant octet. NCPS values are 0000 or 0121.
3:120	**Quantisation Method**	Mandatory, not repeatable, one octet. Not valid when DataSet 3:60 octet zero (0) is 0 (zero). Contains a binary number identifying the quantisation law.The relations between different quantisation methods are described in DNPR Guideline 1. Allowed values are: 0 - Linear reflectance/transmittance 1 - Linear density 2 - IPTC ref "B" 3 - Linear Dot Percent 4 - AP Domestic Analogue 5 - Compression method specific 6 - Colour Space Specific 7 - Gamma Compensated

Other values are reserved for future use.

0 - Linear Reflectance/transmittance:

The domain in which the relative reflectance/transmittance of an image is mapped linearly onto a finite scale of integers (CCITT T1).

1 - Linear Density:

The domain in which the relative density of an image is mapped linearly onto a finite scale of integers.

2 - IPTC Ref “B”

Defined by IPTC in 1985 and amended in January 1990 to suppress reference to “Pixel Density.” (see Appendix H)

3 - Linear Dot Percent

The domain in which the relative dot percent of an image is mapped linearly onto a finite scale of integers.

4 - AP Domestic Analogue

This may be described mathematically as either [√(linear density)] or [√(log (reflectance/transmittance))].

5 - Compression Method Specific.
Defined within the compression method (refer to Appendix A).

6 - Colour Space Specific. quantisation method is contained within the Colour Space definition for DataSet 3:64 values of 1,2,3,6 or 7.

7 - Gamma Compensated - the domain in which the relative reflectance/transmittance is raised to the power of the inverse of gamma.

Note: For quantisation methods 0 and 1, ascending values correspond to increasing reflectance/transmittance.

NCPS values are 0 or 5.

3:125 End Points

Mandatory, not repeatable, 2n octets. Valid only when DataSet 3:64 has a value of 0,1,2,4 or 5. Not relevant for other colour spaces.

These end points apply to the coding process. n = the number of octets per component as derived from 3:135 multiplied by the number of components. The number of components is 1 when octet one (1) of DataSet 3:60 has a value of one (1), in all other cases the number is defined in octet zero (0) of DataSet 3:60.

The first n octets contain the values representing the minimum density that is encoded for each component in the order specified in DataSet 3:65.

The second n octets contain the values representing the maximum density that is encoded for each component in the order specified in DataSet 3:65.

The difference between the maximum and minimum density for every component is the same and given by the Maximum Density Range value in DataSet 3:140.
NCPS end point values are 255 and 0.

3:130 Excursion Tolerance

Mandatory, not repeatable, one octet. Not valid when DataSet 3:60 octet zero (0) is 0 (zero).

Indicates if values outside the range defined by the end points in DataSet 3:125 may occur.

Allowed values are:

0: Not Allowed (default)
1: May occur

NCPS value is 0.

3:135	**Bits Per Component**	Mandatory, not repeatable. The number of octets is 1 when octet one (1) of DataSet 3:60 has a value of one (1), in all other cases the number of octets is equivalent to the number of components specified in octet zero (0) of DataSet 3:60. Contains a sequence of one or more octets describing the number of bits used to encode each component. The sequence is specified by the order of components in DataSet 3:65. Each octet contains a binary value between one and 16. NCPS values are 8 or 888.
3:140	**Maximum Density Range**	Mandatory, not repeatable. Not valid when DataSet 3:60 octet zero (0) is 0 (zero).Two octets, containing a binary value which specifies the maximum density range multiplied by 100. The value represents the difference between the lowest density and the highest density points that can be encoded by the originating system. NCPS value is 160.
3:145	**Gamma Compensated Value**	Optional, not repeatable. Valid only when DataSet 3:120 has a value of 5 or 7. Two octets containing a binary value which specifies the value of gamma for the device multiplied by 100. If this DataSet is omitted receiving equipment should assume that a gamma value of 2.22 applies NCPS value is 222

APPENDIX A

COMPRESSION ALGORITHM PROVIDERS/OWNERS (DataSet 3:110)

The following Compression Algorithm Providers/Owners have been registered by the NAA and IPTC:

(Octets 0-1)Algorithm Provider/Owner Ident No	Octet 2 Type	Octet 3 Revision no.
01 (International Organization for Standardization (ISO))	1 JPEG	1 ITU-T Rec T.81 /ISO/IEC 10918-1
	2 JFIF	1 1.01(December 10,1991)
		2 1.02(September 1,1992)

[NOTE: In the case of ISO, IPTC manages the Algorithm Octet 2 allocation. For the JPEG algorithm it is 1.

02 (Hasselblad Electronic Imaging)	2	1
	3	1

APPENDIX B

ADDRESSES OF ORGANISATIONS MENTIONED

Newspaper Association of America (formerly American Newspaper Publishers Association)
1921 Gallows Road
Suite 600
Vienna
VA 22182-3900
USA
Telephone +1 (1)703 902 1600
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APPENDIX C

MANUFACTURERS I.D. NUMBERS (DataSet 3:10)

NOTE: The Manufacturer’s Identification Numbers (Octets 0 - 5) are allocated thus:

Octets 0 - 1: Manufacturer’s Unique Identity (issued by IPTC)

Octets 2 - 5: Used to indicate equipment type and managed by Manufacturer.

The following series of numbers have been assigned by IPTC-NAA for manufacturers of image originating devices.

01	Associated Press, East Brunswick, NJ, USA
02	Eastman Kodak Co, Rochester, NY, USA
03	Hasselblad Electronic Imaging, Göteborg, Sweden
04	Tecnavia SA, Agno, Switzerland
05	Nikon Corporation, Tokyo, Japan
06	Coatsworth Communications Inc. Canada
07	Agence France Presse, Paris, France
08	T/One Inc. c/o SEG, Cambridge, MA, USA
09	Associated Newspapers, UK
10	Reuters London
11	Sandia Imaging Systems Inc, Carrollton, TX, USA
12	Deutsche Presse-Agentur GmbH, Hamburg, Germany
13	Visualize, Madrid, Spain

APPENDIX D

DEFINITION OF THE NEWSPHOTO COMMON PARAMETER SET

The Newsphoto Common Parameter Set (NCPS) is intended to ensure that images may be interchanged between complying equipment, whether or not they support the entire range of DataSets contained within the IIM and DNPR.

The NCPS consists of a common selection of DataSets from the IIM and DNPR. There are five modes for the NCPS. These modes differ in the type of image they support. For each mode values have been assigned to the DataSets. These modes are defined below:

Mode 1: Monochrome Uncompressed Image

Mode 2: Colour Uncompressed Image

Mode 3: Monochrome Compressed Image

Mode 4: Colour Compressed Planar Image

Mode 5: Colour Compressed Composite Image

The selected parameter values are also indicated in the document text and are summarised below.

NCPS Modes and DataSets

	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	
				Colour	Colour	
Record	Mono	Colour	Mono	Planar	Composite	Note
DataSet	Uncomp	Uncomp Comp	Comp	Comp		
1:00	>=2	>=2	>=2	>=2	>=2	version number
1:20	01	01	01	01	01	
1:22	>=2	>=2	>=2	>=2	>=2	version number
1:30		user provided value in every case				
1:40		user provided value in every case				

1:60	160	160	160	160	160	
1:70	date	date	date	date	date	
	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	
				Colour	Colour	
Record	Mono	Colour	Mono	Planar	Composite	Note
DataSet	Uncomp	Uncomp Comp	Comp	Comp		
3:00	>=2	>=2	>=2	>=2	>=2	version number
3:10		user provided value in every case				
3:20	1024	1024	1024	1024	1024	both value
3:20	2048	2048	2048	2048	2048	options required
3:30	2048	2048	2048	2048	2048	range 1 to 2048 but <= 3:20
3:40	1	1	1	1	1	
3:50	1	1	1	1	1	
3:60	1 0	3 1	1 0	3 1	3 5	
3:64	0	4	0	4	7	not required monochrome
3:65	0	n	0	n	1 2 3	n = 1, 2 or 3
3:90	0	0	0	0	2	
3:100	0	0	0	0	00	
3:110	0 0 0 0	0 0 0 0	0 1 2 1	0 1 2 1	0 1 2 1	
3:120	0	0	5	5	5	
3:125	255	255	255	255	255	
	0	255	0	255	255	
		255		255	255	
		0		0	0	
		0		0	0	
		0		0	0	
3:130	0	0	0	0	0	
3:135	8	8 8 8	8	8 8 8	8 8 8	
3:140	160	160	160	160	160	
3:145			222	222	222	

Where equipment uses the NCPS the mode of operation must be agreed prior to image interchange. This will ensure compatibility between applications.

Users may wish to supplement the NCPS with other IPTC DataSets. Record No. 2 DataSets are not mandatory in the NCPS for information transfer. However, for regular operational use it is likely that Record No. 2 DataSets will be included for editorial purposes.

NCPS modes are not hierarchical. Mode 3, for example, does not imply that modes 1 and 2 are supported.

Implementors should ensure that the data is not rejected if the DataSets outside the NCPS are encountered. Such information should be interpreted and used to maximum advantage.

APPENDIX E

COLOUR SPACE DEFINITIONS

In 1931 the CIE (Commission Internationale de L'Eclairage) proposed a system of colour measurement based on studies of colour vision which showed that all observers with normal colour vision (some 92% of the population) require approximately the same amount of three stimuli to be mixed to match any colour. This enabled the CIE to define the standard observer as the mean of the normal population and to specify three stimuli as the basis of the measurement system. The combination of these enable us to specify a colour by defining how much of each of the three reference stimuli would be required by a standard observer in order to match it.

The amount of each stimuli required to match a colour are known as Tristimulus Values. For the reference stimuli these values are X, Y and Z. Generally, they are normalised such that Y=100 for any specific illuminant used for the assessment of the colour. The CIE also specified the spectral characteristics of a number of reference illuminants (which have been extended subsequently).

Different transformations of XYZ have been proposed for various reasons. Some are in an attempt to define a more uniform colour space and in 1976 the CIE ratified two such transformations. In the Graphic Arts Industry the non-linear transformation known as CIELAB is generally the preferred of the two. Other transformations, such as YUV, are based upon the phosphors used in television rather than the primaries defined by the CIE. These have the advantage for the application that the values can be used to directly drive the television 'guns' without any transformation.

Most modern measuring instruments enable the user to determine the Tristimulus Values, for most widely accepted transformations and illuminants, with relative ease. For the purposes of this standard it is assumed that measurements will be made with an instrument using 0/45 (or 45/0) geometry.

Further information pertaining to this colour measuring system may be found in CIE Publication 15.2 (1986) or various textbooks. Measuring Colour by R.W.G. Hunt is an excellent example of such a text.

For the six colour spaces specified in 3:64 the following definitions apply:

1) CIE X,Y,Z

The Tristimulus Values computed according to the CIE 2^{o} standard colorimetric observer using illuminant D5000.

The identification numbers of the components are:-

1 = X

2 = Y

3 = Z

2) RGB SMPTE

This is based upon the SMPTE phosphors and is commonly taken to be equivalent to the NTSC standard. The co-ordinates of the SMPTE phosphors are:

Red	x = 0.635, y = 0.340
Green	x = 0.305, y = 0.595
Blue	x = 0.155, y = 0.070

The default white point is:

D65 (6504K) with co-ordinates x = 0.313, y = 0.329

For a linear system RGB would be defined by the following matrix transformation of XYZ:

$$\begin{vmatrix} X \\ Y \\ Z \end{vmatrix} = \begin{vmatrix} 0.6069 & 0.1735 & 0.2003 \\ 0.2989 & 0.5866 & 0.1144 \\ 0.0000 & 0.0661 & 1.1157 \end{vmatrix} * \begin{vmatrix} E^{\gamma}{}_{R} \\ E^{\gamma}{}_{G} \\ E^{\gamma}{}_{B} \end{vmatrix}$$

The typical gamma (γ) value used is 2.2.

The identification numbers for the colour components are:

1 = R

2 = G

3 = B

Further details are to be found in the following publications:

Color Monitor Colorimetry, SMPTE Recommended Practice RP 145 - 1987.

Colour Temperature for Color Television Studio Monitors, SMPTE Recommended Practice RP 37.

Colour Science in Television and Display Systems, by W N Sproson

3) YUV(K) (Based on the standard EBU phosphors used in many monitors). The co-ordinates for these phosphors are:-

R	X = 0.64	Y = 0.33
G	X = 0.29	Y = 0.6
B	X = 0.15	Y = 0.06

For a linear system YUV would be defined by the following matrix transformation of XYZ :-

$$\begin{vmatrix} X \\ Y \\ Z \end{vmatrix} = \begin{vmatrix} 0.951 & 0.226 & 0.293 \\ 1.000 & -0.135 & -0.158 \\ 1.089 & 1.853 & -0.053 \end{vmatrix} * \begin{vmatrix} Y \\ U \\ V \end{vmatrix}$$

(Note that Y as defined by this system is not exactly equivalent to Y as defined by the CIE system, which it should be. This is due to a decision to encode using NTSC luminance coding coefficients).

Gamma correction - In general YUV is encoded with gamma correction of 2.2 to correct for the power relationship between voltage and intensity required by monitors. This complicates the transformation above and produces the following matrix transformation:

$$\begin{vmatrix} X \\ Y \\ Z \end{vmatrix} = \begin{vmatrix} 0.431A + 0.342B + 0.178C & -0.135B + 0.361C & 0.491A - 0.199B \\ 0.222A + 0.707B + 0.071C & -0.279B + 0.144C & 0.253A - 0.411B \\ 0.020A + 0.130B + 0.939C & -0.051B + 1.904C & 0.023A - 0.076B \end{vmatrix} * \begin{vmatrix} Y \\ U \\ V \end{vmatrix}$$

where $A=E(r)^{1.2}$, $B=E(g)^{1.2}$ and $C=E(b)^{1.2}$ and E(r), E(g) and E(b) are the voltages required to drive the monitor. They are related to the intensity by a power law with the exponent 2.2. (Note: the gamma value is not specified in any standard, the value 2.2 is the classical NTSC value).

The identification numbers of the components are:-

1 = Y

2 = U

3 = V

4 = K

4) Device dependent RGB

Data, generally obtained directly from a scanner, which does not conform to one of the above definitions. It will normally be accompanied by a calibration matrix such as that defined in 3:70 or Appendix F.

The identification numbers of the components are:-

1 = R

2 = G

3 = B

5) Device dependent CMY(K)

Data which has already been processed to define the ink amounts required by a specific printing process. It will frequently be accompanied by a calibration matrix such as that defined in 3:70 or Appendix F or produced to some agreed printing ‘standard’.

The identification numbers of the components are:-

1 = C

2 = M

3 = Y

4 = K

6) CIELAB

Defined by the following transformation of XYZ where X_o, Y_o, Z_o are the values of the reference white. (For this definition these are the values of illuminant D50 and are defined as X_o= 96.42, Y_o = 100, Z_o = 82.49).

$L^* = 116(Y/Y_o)^{1/3} - 16$

$a^* = 500[(X/X_o)^{1/3} - (Y/Y_o)^{1/3}]$

$b^* = 200[(Y/Y_o)^{1/3} - (Z/Z_o)^{1/3}]$

(Note: From this definition a and b take on negative as well as positive values. Both should be encoded such that -128 is encoded by 0 and +127 is encoded by 255.)

The identification numbers of the components are:-

1 = L^*

2 = a^*

3 = b^*

7) Y,C_b,C_r using the JPEG File Interchange Format (JFIF)

Y, C_b, and C_r are converted from R, G, and B as defined in CCIR recommendation 601 but are normalised so as to occupy the full 256 levels of an 8 bit binary encoding.

$$Y = 256 * E'y$$

$$C_b = 256 * [E'C_b] +128$$

$$C_r = 256 * [E'C_r] +128$$

where

$$E'y = 0.299E'R + 0.587E'G + 0.114E'B$$

and

$$E'C_b = -0.169E'R - 0.331E'G + 0.500E'B$$

$$E'C_r = 0.500E'R - 0.419E'G - 0.081E'B$$

where $E'C_r$ and $E'C_b$ are the re-normalised red and blue colour-difference signals respectively. E'R, E'G, and E'B are the gamma pre-corrected signals.

Since values of E'y have a range of 0 to 1.0 and those for $E'C_b$ and $E'C_r$ have a range of -0.5 to +0.5, Y, C_b, and C_r must be clamped to 255 when they are maximum value.

RGB to YC_bC_r conversion

YC_bC_r (256 levels) can be computed directly from 8 bit RGB as follows:

$$Y = 0.299R + 0.587G + 0.114B$$

$$C_b = -0.1687R - 0.3313G + 0.5B$$

$$C_r = 0.5R - 0.4187G - 0.0813B$$

YC_bC_r to RGB conversion

RGB can be computed directly from YC_bC_r (256 levels) as follows:

$$R = Y + 1.402C_r$$

$$G = Y - 0.3437C_b - 0.7143C_r$$

$$B = Y + 1.77C_b$$

The identification numbers for the colour components are:

1 = Y

2 = C_b

3 = C_r

Further information can be found in the JPEG File Interchange Format Specification.

8) sRGB (Standard RGB)

This standard was originally proposed in IEC 100/43/NP.

CAUTION: The sRGB specification is still under development and the definition that follows may be superseded or modified during the lifetime of this version of the DNPR.

sRGB in combination with the reference viewing environments can be defined from standard CIE colorimetric values through simple mathematical transformations.
CIE colorimetry provides the basis for sRGB encoding of the colour. For the calculation of CIE colorimetric values, it is necessary to specify a viewing environment and a set of spectral sensitivities for a specific capture device.
The definitions for RGB given in equations 1.1 to 1.3 are based on the colour space's respective viewing environment.
The CIE chromaticities for the red, green, and blue ITU-R BT.709 reference primaries, and for CIE Standard Illuminant D 65, are given in Table 0.2.

TABLE 0.2 CIE chromaticities for ITU-R BT.709 reference primaries and CIE standard illuminant				
	Red	Green	Blue	D65
	0.6400	0.3000	0.1500	0.3127
	0.3300	0.6000	0.0600	0.3290
	0.0300	0.1000	0.7900	0.3583

sRGB tristimulus values for the illuminated objects of the scene are simply linear combinations of the 1931 CIE XYZ values and these RGB tristimulus values can be computed using the following derived relationship:

$$\begin{bmatrix} R_{sRGB} \\ G_{sRGB} \\ B_{sRGB} \end{bmatrix} = \begin{bmatrix} 3.2410 & -1.5374 & -0.4986 \\ -0.9692 & 1.8760 & 0.0416 \\ 0.0556 & -0.2040 & 1.0570 \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \end{bmatrix}$$

(1.1)

In the RGB encoding process, negative sRGB tristimulus values, and sRGB tristimulus values greater than 1.00 are not typically retained. When encoding software cannot support this extended range, the luminance dynamic range and colour gamut of RGB is limited to the tristimulus values between 0.0 and 1.0 by simple clipping. This gamut, however, is large enough to encompass most colours that can be displayed on CRT monitors.

The sRGB tristimulus values are next transformed to non-linear sR'G'B' values as follows:

If

$$R_{sRGB}, G_{sRGB}, B_{sRGB} \leq 0.00304$$

$$\begin{aligned} R'_{sRGB} &= 12.92 \times R_{sRGB} \\ G'_{sRGB} &= 12.92 \times G_{sRGB} \\ B'_{sRGB} &= 12.92 \times B_{sRGB} \end{aligned} \tag{1.2a}$$

else if

$$R_{sRGB}, G_{sRGB}, B_{sRGB} > 0.00304$$

$$\begin{aligned} R'_{sRGB} &= 1.055 \times R_{sRGB}^{(1.0/2.4)} - 0.055 \\ G'_{sRGB} &= 1.055 \times G_{sRGB}^{(1.0/2.4)} - 0.055 \\ B'_{sRGB} &= 1.055 \times B_{sRGB}^{(1.0/2.4)} - 0.055 \end{aligned} \tag{1.2b}$$

The effect of the above equations closely fit a simple power function with an exponent 0f 1.0/2.2. Therefore, we are maintaining consistency with the legacy of desktop and video images.

Finally, the non-linear sR'G'B' values are converted to digital code values. This conversion scales the above sR'G'B' values by using the equation below where WDC represents the white digital count and KDC represents the black digital count.

$$R_{8bit} = ((WDC - KDC) \times R'_{sRGB}) + KDC$$
$$G_{8bit} = ((WDC - KDC) \times G'_{sRGB}) + KDC$$
$$B_{8bit} = ((WDC - KDC) \times B'_{sRGB}) + KDC$$

(1.3)

This current specification proposes using a black digital count of 0 and a white digital count of 255 for 24-bit (8-bits/channel) encoding. The resulting RGB values are formed according to the following equations:

$$R_{8bit} = ((255.0 - 0.0) \times R'_{sRGB}) + 0.0$$
$$G_{8bit} = ((255.0 - 0.0) \times G'_{sRGB}) + 0.0$$
$$B_{8bit} = ((255.0 - 0.0) \times B'_{sRGB}) + 0.0$$

(1.4)

This obviously can be simplified as shown below.

$$R_{8bit} = 255.0 \times R'_{sRGB}$$
$$G_{8bit} = 255.0 \times G'_{sRGB}$$
$$B_{8bit} = 255.0 \times B'_{sRGB}$$

(1.5)

The reverse relationship is defined as follows;

$$R'_{sRGB} = R_{8bit} \div 255.0$$
$$G'_{sRGB} = G_{8bit} \div 255.0$$
$$B'_{sRGB} = B_{8bit} \div 255.0$$

(1.6)

If

$$R_{sRGB}, G_{sRGB}, B_{sRGB} \leq 0.03928$$

$$R_{sRGB} = R'_{sRGB} \div 12.92$$
$$G_{sRGB} = G'_{sRGB} \div 12.92$$
$$B_{sRGB} = B'_{sRGB} \div 12.92$$

(1.7a)

else if

$$R_{sRGB}, G_{sRGB}, B_{sRGB} > 0.03928$$

and

$$R_{sRGB} = [(R'_{sRGB} + 0.055)/1.055]^{2.4}$$
$$G_{sRGB} = [(G'_{sRGB} + 0.055)/1.055]^{2.4}$$
$$B_{sRGB} = [(B'_{sRGB} + 0.055)/1.055]^{2.4}$$

(1.7b)

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = \begin{bmatrix} 0.4124 & 0.3576 & 0.1805 \\ 0.2126 & 0.7152 & 0.0722 \\ 0.0193 & 0.1192 & 0.9505 \end{bmatrix} \begin{bmatrix} R_{sRGB} \\ G_{sRGB} \\ B_{sRGB} \end{bmatrix}$$

(1.8)

Digital broadcast television uses a black digital count of 16 and a white digital count of 235 in order to provide a larger encoded colour gamut. We do not propose using this encoding at this time, due to the large legacy of images and applications using the previous black and white digital coding counts.
However, it is vital to allow for a future revision to provide this capability.

APPENDIX F

FUTURE COLOUR CALIBRATION METHODS

Other groups, such as the Inter Color Consortium and ISO TC130 WG2 are working on a standard RGB colour space for the Internet and other purposes. This is reflected in the entries for DataSets 3:64 and P3:66.

APPENDIX G

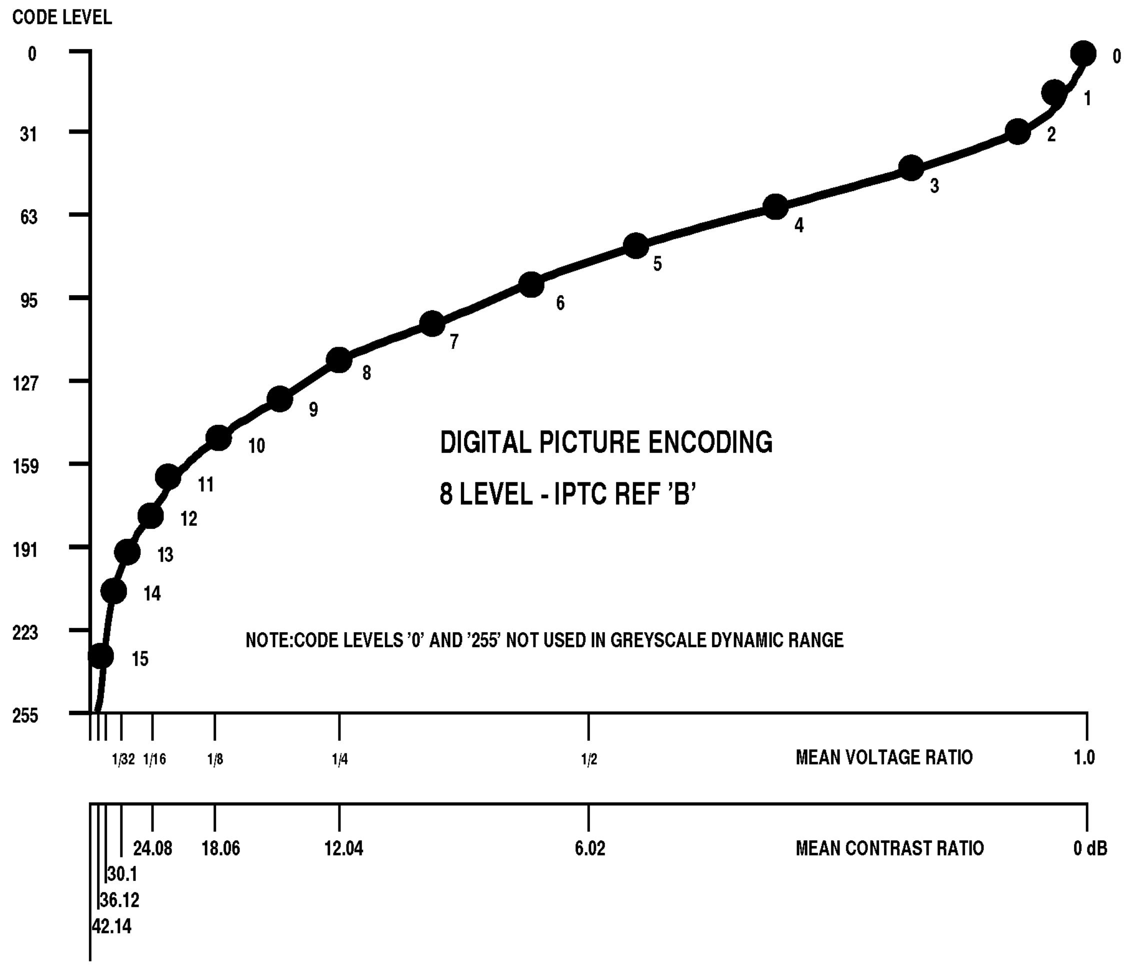
SAMPLING STRUCTURES (DataSet 3:90)

To be issued later.

APPENDIX H

QUANTISATION METHODS (DataSet 3:120)

IPTC Reference "B".



Quantisation Table

	MEAN		**MAX**		**MIN**	
Code Level	Voltage Level	Contrast Ratio	Voltage Level	Contrast Ratio	Voltage Level	Contrast Ratio
1	1.000000E+00	0.000000	1.000000E+00	0.000000	9.995831E-01	-0.003622
2	9.991426E-01	-0.007450	9.995831E-01	-0.003622	9.986786E-01	-0.011485
3	9.981911E-01	-0.015726	9.986786E-01	-0.011485	9.976798E-01	-0.020176
4	9.971451E-01	-0.024833	9.976798E-01	-0.020176	9.965867E-01	-0.029698
5	9.960048E-01	-0.034771	9.965867E-01	-0.029698	9.953994E-01	-0.040053
6	9.947702E-01	-0.045544	9.953994E-01	-0.040053	9.941176E-01	-0.051245
7	9.934413E-01	-0.057156	9.941176E-01	-0.051245	9.927415E-01	-0.063276
8	9.920181E-01	-0.069608	9.927415E-01	-0.063276	9.912711E-01	-0.076151
9	9.905006E-01	-0.082905	9.912711E-01	-0.076151	9.897064E-01	-0.089872
10	9.888887E-01	-0.097051	9.897064E-01	-0.089872	9.880475E-01	-0.104444
11	9.871826E-01	-0.112050	9.880475E-01	-0.104444	9.862942E-01	-0.119871
12	9.853822E-01	-0.127906	9.862942E-01	-0.119871	9.844466E-01	-0.136157
13	9.834874E-01	-0.144624	9.844466E-01	-0.136157	9.825047E-01	-0.153308
14	9.814984E-01	-0.162208	9.825047E-01	-0.153308	9.804684E-01	-0.171328
15	9.794149E-01	-0.180666	9.804684E-01	-0.171328	9.783379E-01	-0.190223
16	9.772372E-01	-0.200000	9.783379E-01	-0.190223	9.768504E-01	-0.203439
17	9.763892E-01	-0.207541	9.768504E-01	-0.203439	9.758535E-01	-0.212307
18	9.752434E-01	-0.217740	9.758535E-01	-0.212307	9.745588E-01	-0.223839
19	9.737999E-01	-0.230606	9.745588E-01	-0.223839	9.729664E-01	-0.238043
20	9.720587E-01	-0.246151	9.729664E-01	-0.238043	9.710763E-01	-0.254933
21	9.700196E-01	-0.264390	9.710763E-01	-0.254933	9.688885E-01	-0.274524
22	9.676829E-01	-0.285339	9.688885E-01	-0.274524	9.664029E-01	-0.296836
23	9.650484E-01	-0.309018	9.664029E-01	-0.296836	9.636195E-01	-0.321888
24	9.621162E-01	-0.335449	9.636195E-01	-0.321888	9.605384E-01	-0.349705
25	9.588863E-01	-0.364657	9.605384E-01	-0.349705	9.571597E-01	-0.380312
26	9.553586E-01	-0.396671	9.571597E-01	-0.380312	9.534832E-01	-0.413739
27	9.515333E-01	-0.431521	9.534832E-01	-0.413739	9.495089E-01	-0.450019
28	9.474101E-01	-0.469240	9.495089E-01	-0.450019	9.452369E-01	-0.489186
29	9.429893E-01	-0.509865	9.452369E-01	-0.489186	9.406672E-01	-0.531280
30	9.382707E-01	-0.553437	9.406672E-01	-0.531280	9.357998E-01	-0.576341
31	9.332544E-01	-0.599999	9.357998E-01	-0.576341	9.301137E-01	-0.629279
32	9.269372E-01	-0.658994	9.301137E-01	-0.629279	9.237249E-01	-0.689147
33	9.204767E-01	-0.719744	9.237249E-01	-0.689147	9.171926E-01	-0.750789
34	9.138727E-01	-0.782286	9.171926E-01	-0.750789	9.105170E-01	-0.814239
35	9.071254E-01	-0.846654	9.105170E-01	-0.814239	9.036979E-01	-0.879534
36	9.002346E-01	-0.912886	9.036979E-01	-0.879534	8.967354E-01	-0.946713
37	8.932004E-01	-0.981022	8.967354E-01	-0.946713	8.896295E-01	-1.015816
38	8.860228E-01	-1.051102	8.896295E-01	-1.015816	8.823801E-01	-1.086886
39	8.787017E-01	-1.123170	8.823801E-01	-1.086886	8.749875E-01	-1.159963
40	8.712373E-01	-1.197271	8.749875E-01	-1.159963	8.674513E-01	-1.235098
41	8.636295E-01	-1.273451	8.674513E-01	-1.235098	8.597717E-01	-1.312337
42	8.558782E-01	-1.351761	8.597717E-01	-1.312337	8.519487E-01	-1.391731
43	8.479835E-01	-1.432252	8.519487E-01	-1.391731	8.439823E-01	-1.473333
44	8.399453E-01	-1.514980	8.439823E-01	-1.473333	8.358725E-01	-1.557199
45	8.317638E-01	-1.600000	8.358725E-01	-1.557199	8.271374E-01	-1.648447
46	8.225083E-01	-1.697194	8.271374E-01	-1.648447	8.178766E-01	-1.746245
47	8.132423E-01	-1.795601	8.178766E-01	-1.746245	8.086054E-01	-1.845268
48	8.039658E-01	-1.895248	8.086054E-01	-1.845268	7.993237E-01	-1.945546
49	7.946789E-01	-1.996167	7.993237E-01	-1.945546	7.900315E-01	-2.047112
50	7.853815E-01	-2.098387	7.900315E-01	-2.047112	7.807288E-01	-2.149996
51	7.760736E-01	-2.201942	7.807288E-01	-2.149996	7.714157E-01	-2.254230
52	7.667552E-01	-2.306865	7.714157E-01	-2.254230	7.620921E-01	-2.359851
53	7.574263E-01	-2.413192	7.620921E-01	-2.359851	7.527580E-01	-2.466893
54	7.480870E-01	-2.520957	7.527580E-01	-2.466893	7.434134E-01	-2.575392
55	7.387372E-01	-2.630200	7.434134E-01	-2.575392	7.340584E-01	-2.685388

Quantisation Table

Code Level	MEAN Voltage Level	MEAN Contrast Ratio	MAX Voltage Level	MAX Contrast Ratio	MIN Voltage Level	MIN Contrast Ratio
56	7.293769E-01	-2.740960	7.340584E-01	-2.685388	7.246929E-01	-2.796920
57	7.200062E-01	-2.853276	7.246929E-01	-2.796920	7.153169E-01	-2.910030
58	7.106249E-01	-2.967191	7.153169E-01	-2.910030	7.059304E-01	-3.024762
59	7.012332E-01	-3.082751	7.059304E-01	-3.024762	6.965334E-01	-3.141160
60	6.918311E-01	-3.199999	6.965334E-01	-3.141160	6.866165E-01	-3.265715
61	6.814346E-01	-3.331517	6.866165E-01	-3.265715	6.762851E-01	-3.397404
62	6.711681E-01	-3.463373	6.762851E-01	-3.397404	6.660837E-01	-3.529424
63	6.610318E-01	-3.595553	6.660837E-01	-3.529424	6.560124E-01	-3.661759
64	6.510255E-01	-3.728040	6.560124E-01	-3.661759	6.460711E-01	-3.794393
65	6.411493E-01	-3.860816	6.460711E-01	-3.794393	6.362600E-01	-3.927308
66	6.314032E-01	-3.993864	6.362600E-01	-3.927308	6.265789E-01	-4.060485
67	6.217871E-01	-4.127166	6.265789E-01	-4.060485	6.170278E-01	-4.193905
68	6.123011E-01	-4.260700	6.170278E-01	-4.193905	6.076069E-01	-4.327546
69	6.029451E-01	-4.394444	6.076069E-01	-4.327546	5.983160E-01	-4.461388
70	5.937192E-01	-4.528378	5.983160E-01	-4.461388	5.891551E-01	-4.595407
71	5.846235E-01	-4.662475	5.891551E-01	-4.595407	5.801243E-01	-4.729578
72	5.756577E-01	-4.796714	5.801243E-01	-4.729578	5.712236E-01	-4.863877
73	5.668221E-01	-4.931065	5.712236E-01	-4.863877	5.624530E-01	-4.998276
74	5.581164E-01	-5.065505	5.624530E-01	-4.998276	5.538124E-01	-5.132747
75	5.495409E-01	-5.200000	5.538124E-01	-5.132747	5.453989E-01	-5.265715
76	5.412827E-01	-5.331518	5.453989E-01	-5.265715	5.371923E-01	-5.397405
77	5.331278E-01	-5.463374	5.371923E-01	-5.397405	5.290891E-01	-5.529424
78	5.250762E-01	-5.595554	5.290891E-01	-5.529424	5.210891E-01	-5.661759
79	5.171279E-01	-5.728040	5.210891E-01	-5.661759	5.131925E-01	-5.794394
80	5.092829E-01	-5.860817	5.131925E-01	-5.794394	5.053992E-01	-5.927309
81	5.015413E-01	-5.993865	5.053992E-01	-5.927309	4.977093E-01	-6.060485
82	4.939030E-01	-6.127167	4.977093E-01	-6.060485	4.901226E-01	-6.193906
83	4.863680E-01	-6.260700	4.901226E-01	-6.193906	4.826393E-01	-6.327547
84	4.789363E-01	-6.394444	4.826393E-01	-6.327547	4.752592E-01	-6.461389
85	4.716079E-01	-6.528378	4.752592E-01	-6.461389	4.679825E-01	-6.595407
86	4.643829E-01	-6.662476	4.679825E-01	-6.595407	4.608091E-01	-6.729579
87	4.572611E-01	-6.796714	4.608091E-01	-6.729579	4.537390E-01	-6.863877
88	4.502427E-01	-6.931067	4.537390E-01	-6.863877	4.467722E-01	-6.998276
89	4.433276E-01	-7.065505	4.467722E-01	-6.998276	4.399088E-01	-7.132747
90	4.365158E-01	-7.200000	4.399088E-01	-7.132747	4.337331E-01	-7.255549
91	4.309359E-01	-7.311747	4.337331E-01	-7.255549	4.281242E-01	-7.368605
92	4.252980E-01	-7.426133	4.281242E-01	-7.368605	4.224574E-01	-7.484342
93	4.196023E-01	-7.543243	4.224574E-01	-7.484342	4.167327E-01	-7.602849
94	4.138486E-01	-7.663169	4.167327E-01	-7.602849	4.109501E-01	-7.724218
95	4.080371E-01	-7.786008	4.109501E-01	-7.724218	4.051096E-01	-7.848550
96	4.021676E-01	-7.911858	4.051096E-01	-7.848550	3.992112E-01	-7.975946
97	3.962403E-01	-8.040828	3.992112E-01	-7.975946	3.932549E-01	-8.106518
98	3.902550E-01	-8.173031	3.932549E-01	-8.106518	3.872406E-01	-8.240381
99	3.842118E-01	-8.308586	3.872406E-01	-8.240381	3.811685E-01	-8.377660
100	3.781107E-01	-8.447619	3.811685E-01	-8.377660	3.750385E-01	-8.518483
101	3.719518E-01	-8.590268	3.750385E-01	-8.518483	3.688506E-01	-8.662992
102	3.657349E-01	-8.736672	3.688506E-01	-8.662992	3.626047E-01	-8.811331
103	3.594601E-01	-8.886986	3.626047E-01	-8.811331	3.563010E-01	-8.963659
104	3.531274E-01	-9.041371	3.563010E-01	-8.963659	3.499394E-01	-9.120144
105	3.467368E-01	-9.200001	3.499394E-01	-9.120144	3.426768E-01	-9.302305
106	3.386648E-01	-9.404598	3.426768E-01	-9.302305	3.347008E-01	-9.506866
107	3.307847E-01	-9.609092	3.347008E-01	-9.506866	3.269166E-01	-9.711261
108	3.230965E-01	-9.813356	3.269166E-01	-9.711261	3.193243E-01	-9.915361
109	3.156000E-01	-10.017259	3.193243E-01	-9.915361	3.119238E-01	-10.119030
110	3.082955E-01	-10.220655	3.119238E-01	-10.119030	3.047152E-01	-10.322117

Quantisation Table

Code Level	MEAN Voltage Level	MEAN Contrast Ratio	MAX Voltage Level	MAX Contrast Ratio	MIN Voltage Level	MIN Contrast Ratio
111	3.011828E-01	-10.423395	3.047152E-01	-10.322117	2.976985E-01	-10.524468
112	2.942621E-01	-10.625315	2.976985E-01	-10.524468	2.908736E-01	-10.725914
113	2.875331E-01	-10.826243	2.908736E-01	-10.725914	2.842406E-01	-10.926278
114	2.809960E-01	-11.025996	2.842406E-01	-10.926278	2.777995E-01	-11.125372
115	2.746508E-01	-11.224381	2.777995E-01	-11.125372	2.715502E-01	-11.322998
116	2.684975E-01	-11.421196	2.715502E-01	-11.322998	2.654928E-01	-11.518946
117	2.625360E-01	-11.616223	2.654928E-01	-11.518946	2.596272E-01	-11.712996
118	2.567664E-01	-11.809237	2.596272E-01	-11.712996	2.539535E-01	-11.904916
119	2.511886E-01	-12.000000	2.539535E-01	-11.904916	2.491846E-01	-12.069577
120	2.471793E-01	-12.139756	2.491846E-01	-12.069577	2.451729E-01	-12.210550
121	2.431653E-01	-12.281969	2.451729E-01	-12.210550	2.411564E-01	-12.354023
122	2.391464E-01	-12.426723	2.411564E-01	-12.354023	2.371352E-01	-12.500080
123	2.351227E-01	-12.574107	2.371352E-01	-12.500080	2.331091E-01	-12.648815
124	2.310943E-01	-12.724216	2.331091E-01	-12.648815	2.290783E-01	-12.800323
125	2.270610E-01	-12.877149	2.290783E-01	-12.800323	2.250426E-01	-12.954705
126	2.230230E-01	-13.033008	2.250426E-01	-12.954705	2.210022E-01	-13.112069
127	2.189801E-01	-13.191906	2.210022E-01	-13.112069	2.169569E-01	-13.272530
128	2.149325E-01	-13.353957	2.169569E-01	-13.272530	2.129069E-01	-13.436206
129	2.108801E-01	-13.519289	2.129069E-01	-13.436206	2.088521E-01	-13.603224
130	2.068229E-01	-13.688029	2.088521E-01	-13.603224	2.047925E-01	-13.773721
131	2.027608E-01	-13.860318	2.047925E-01	-13.773721	2.007281E-01	-13.947838
132	1.986941E-01	-14.036303	2.007281E-01	-13.947838	1.966588E-01	-14.125731
133	1.946225E-01	-14.216141	1.966588E-01	-14.125731	1.925848E-01	-14.307558
134	1.905461E-01	-14.400001	1.925848E-01	-14.307558	1.881985E-01	-14.507676
135	1.858710E-01	-14.615767	1.881985E-01	-14.507676	1.835635E-01	-14.724274
136	1.812760E-01	-14.833194	1.835635E-01	-14.724274	1.790085E-01	-14.942526
137	1.767610E-01	-15.052269	1.790085E-01	-14.942526	1.745336E-01	-15.162419
138	1.723261E-01	-15.272977	1.745336E-01	-15.162419	1.701387E-01	-15.383939
139	1.679713E-01	-15.495300	1.701387E-01	-15.383939	1.658238E-01	-15.607061
140	1.636964E-01	-15.719216	1.658238E-01	-15.607061	1.615890E-01	-15.831762
141	1.595016E-01	-15.944696	1.615890E-01	-15.831762	1.574343E-01	-16.058014
142	1.553869E-01	-16.171713	1.574343E-01	-16.058014	1.533595E-01	-16.285784
143	1.513522E-01	-16.400225	1.533595E-01	-16.285784	1.493649E-01	-16.515030
144	1.473975E-01	-16.630196	1.493649E-01	-16.515030	1.454502E-01	-16.745710
145	1.435229E-01	-16.861572	1.454502E-01	-16.745710	1.416157E-01	-16.977774
146	1.397284E-01	-17.094307	1.416157E-01	-16.977774	1.378611E-01	-17.211163
147	1.360139E-01	-17.328337	1.378611E-01	-17.211163	1.341866E-01	-17.445816
148	1.323794E-01	-17.563593	1.341866E-01	-17.445816	1.305922E-01	-17.681658
149	1.288250E-01	-17.799999	1.305922E-01	-17.681658	1.270642E-01	-17.919538
150	1.253243E-01	-18.039291	1.270642E-01	-17.919538	1.236054E-01	-18.159248
151	1.219075E-01	-18.279392	1.236054E-01	-18.159248	1.202305E-01	-18.399706
152	1.185745E-01	-18.520178	1.202305E-01	-18.399706	1.169394E-01	-18.640785
153	1.153252E-01	-18.761515	1.169394E-01	-18.640785	1.137320E-01	-18.882345
154	1.121598E-01	-19.003258	1.137320E-01	-18.882345	1.106085E-01	-19.124233
155	1.090781E-01	-19.245249	1.106085E-01	-19.124233	1.075687E-01	-19.366283
156	1.060802E-01	-19.487312	1.075687E-01	-19.366283	1.046127E-01	-19.608311
157	1.031661E-01	-19.729256	1.046127E-01	-19.608311	1.017405E-01	-19.850121
158	1.003359E-01	-19.970877	1.017405E-01	-19.850121	9.895214E-02	-20.091496
159	9.758937E-02	-20.211950	9.895214E-02	-20.091496	9.624755E-02	-20.332207
160	9.492666E-02	-20.452236	9.624755E-02	-20.332207	9.362675E-02	-20.572002
161	9.234776E-02	-20.691473	9.362675E-02	-20.572002	9.108973E-02	-20.810612
162	8.985265E-02	-20.929382	9.108973E-02	-20.810612	8.863651E-02	-21.047747
163	8.744133E-02	-21.165665	8.863651E-02	-21.047747	8.626708E-02	-21.283098
164	8.511379E-02	-21.400002	8.626708E-02	-21.283098	8.428345E-02	-21.485153
165	8.345322E-02	-21.571138	8.428345E-02	-21.485153	8.262311E-02	-21.657969

Quantisation Table

Code Level	MEAN Voltage Level	MEAN Contrast Ratio	MAX Voltage Level	MAX Contrast Ratio	MIN Voltage Level	MIN Contrast Ratio
166	8.179313E-02	-21.745663	8.262311E-02	-21.657969	8.096326E-02	-21.834240
167	8.013351E-02	-21.923716	8.096326E-02	-21.834240	7.930389E-02	-22.014111
168	7.847439E-02	-22.105440	7.930389E-02	-22.014111	7.764501E-02	-22.197729
169	7.681575E-02	-22.290995	7.764501E-02	-22.197729	7.598662E-02	-22.385258
170	7.515759E-02	-22.480543	7.598662E-02	-22.385258	7.432870E-02	-22.576870
171	7.349992E-02	-22.674263	7.432870E-02	-22.576870	7.267126E-02	-22.772745
172	7.184273E-02	-22.872343	7.267126E-02	-22.772745	7.101432E-02	-22.973082
173	7.018603E-02	-23.074987	7.101432E-02	-22.973082	6.935786E-02	-23.178087
174	6.852981E-02	-23.282410	6.935786E-02	-23.178087	6.770188E-02	-23.387985
175	6.687406E-02	-23.494846	6.770188E-02	-23.387985	6.604638E-02	-23.603020
176	6.521881E-02	-23.712542	6.604638E-02	-23.603020	6.439137E-02	-23.823446
177	6.356405E-02	-23.935770	6.439137E-02	-23.823446	6.273684E-02	-24.049547
178	6.190976E-02	-24.164818	6.273684E-02	-24.049547	6.108280E-02	-24.281622
179	6.025596E-02	-24.400000	6.108280E-02	-24.281622	5.926782E-02	-24.543621
180	5.829176E-02	-24.687857	5.926782E-02	-24.543621	5.732777E-02	-24.832699
181	5.637587E-02	-24.978134	5.732777E-02	-24.832699	5.543604E-02	-25.124155
182	5.450829E-02	-25.270748	5.543604E-02	-25.124155	5.359263E-02	-25.417900
183	5.268903E-02	-25.565596	5.359263E-02	-25.417900	5.179751E-02	-25.713821
184	5.091808E-02	-25.862560	5.179751E-02	-25.713821	5.005072E-02	-26.011793
185	4.919544E-02	-26.161503	5.005072E-02	-26.011793	4.835223E-02	-26.311668
186	4.752111E-02	-26.462269	4.835223E-02	-26.311668	4.670206E-02	-26.613279
187	4.589509E-02	-26.764675	4.670206E-02	-26.613279	4.510020E-02	-26.916430
188	4.431738E-02	-27.068518	4.510020E-02	-26.916430	4.354665E-02	-27.220905
189	4.278799E-02	-27.373562	4.354665E-02	-27.220905	4.204141E-02	-27.526455
190	4.130691E-02	-27.679546	4.204141E-02	-27.526455	4.058448E-02	-27.832800
191	3.987414E-02	-27.986174	4.058448E-02	-27.832800	3.917587E-02	-28.139627
192	3.848968E-02	-28.293116	3.917587E-02	-28.139627	3.781556E-02	-28.446589
193	3.715353E-02	-28.599998	3.781556E-02	-28.446589	3.656294E-02	-28.739178
194	3.598034E-02	-28.878696	3.656294E-02	-28.739178	3.540571E-02	-29.018534
195	3.483908E-02	-29.158669	3.540571E-02	-29.018534	3.428042E-02	-29.299078
196	3.372975E-02	-29.439737	3.428042E-02	-29.299078	3.318706E-02	-29.580624
197	3.265236E-02	-29.721710	3.318706E-02	-29.580624	3.212564E-02	-29.862965
198	3.160690E-02	-30.004362	3.212564E-02	-29.862965	3.109615E-02	-30.145868
199	3.059337E-02	-30.287453	3.109615E-02	-30.145868	3.009859E-02	-30.429077
200	2.961178E-02	-30.570707	3.009859E-02	-30.429077	2.913296E-02	-30.712307
201	2.866213E-02	-30.853830	2.913296E-02	-30.712307	2.819927E-02	-30.995241
202	2.774440E-02	-31.136492	2.819927E-02	-30.995241	2.729752E-02	-31.277536
203	2.685862E-02	-31.418327	2.729752E-02	-31.277536	2.642770E-02	-31.558815
204	2.600476E-02	-31.698942	2.642770E-02	-31.558815	2.558981E-02	-31.838659
205	2.518284E-02	-31.977907	2.558981E-02	-31.838659	2.478385E-02	-32.116623
206	2.439285E-02	-32.254749	2.478385E-02	-32.116623	2.400983E-02	-32.392220
207	2.363480E-02	-32.528961	2.400983E-02	-32.392220	2.326775E-02	-32.664913
208	2.290868E-02	-32.799999	2.326775E-02	-32.664913	2.263937E-02	-32.902714
209	2.237240E-02	-33.005749	2.263937E-02	-32.902714	2.210778E-02	-33.109097
210	2.184550E-02	-33.212761	2.210778E-02	-33.109097	2.158557E-02	-33.316730
211	2.132798E-02	-33.421005	2.158557E-02	-33.316730	2.107273E-02	-33.525585
212	2.081983E-02	-33.630459	2.107273E-02	-33.525585	2.056927E-02	-33.735622
213	2.032105E-02	-33.841076	2.056927E-02	-33.735622	2.007518E-02	-33.946812
214	1.983165E-02	-34.052822	2.007518E-02	-33.946812	1.959047E-02	-34.159103
215	1.935163E-02	-34.265652	1.959047E-02	-34.159103	1.911513E-02	-34.372456
216	1.888098E-02	-34.479511	1.911513E-02	-34.372456	1.864917E-02	-34.586811
217	1.841970E-02	-34.694347	1.864917E-02	-34.586811	1.819258E-02	-34.802113
218	1.796780E-02	-34.910099	1.819258E-02	-34.802113	1.774537E-02	-35.018299
219	1.752528E-02	-35.126701	1.774537E-02	-35.018299	1.730753E-02	-35.235298
220	1.709213E-02	-35.344078	1.730753E-02	-35.235298	1.687907E-02	-35.453030

Quantisation Table

Code Level	MEAN Voltage Level	MEAN Contrast Ratio	MAX Voltage Level	MAX Contrast Ratio	MIN Voltage Level	MIN Contrast Ratio
221	1.666836E-02	-35.562145	1.687907E-02	-35.453030	1.645998E-02	-35.671410
222	1.625396E-02	-35.780819	1.645998E-02	-35.671410	1.605027E-02	-35.890350
223	1.584893E-02	-36.000000	1.605027E-02	-35.890350	1.573619E-02	-36.062008
224	1.562296E-02	-36.124733	1.573619E-02	-36.062008	1.550925E-02	-36.188187
225	1.539505E-02	-36.252377	1.550925E-02	-36.188187	1.528037E-02	-36.317322
226	1.516521E-02	-36.383034	1.528037E-02	-36.317322	1.504956E-02	-36.449524
227	1.493342E-02	-36.516811	1.504956E-02	-36.449524	1.481681E-02	-36.584908
228	1.469971E-02	-36.653828	1.481681E-02	-36.584908	1.458212E-02	-36.723587
229	1.446405E-02	-36.794201	1.458212E-02	-36.723587	1.434550E-02	-36.865688
230	1.422646E-02	-36.938065	1.434550E-02	-36.865688	1.410694E-02	-37.011345
231	1.398693E-02	-37.085552	1.410694E-02	-37.011345	1.386644E-02	-37.160702
232	1.374547E-02	-37.236809	1.386644E-02	-37.160702	1.362401E-02	-37.313904
233	1.350206E-02	-37.391998	1.362401E-02	-37.313904	1.337964E-02	-37.471115
234	1.325673E-02	-37.551273	1.337964E-02	-37.471115	1.313333E-02	-37.632504
235	1.300945E-02	-37.714821	1.313333E-02	-37.632504	1.288509E-02	-37.798252
236	1.276024E-02	-37.882824	1.288509E-02	-37.798252	1.263491E-02	-37.968559
237	1.250909E-02	-38.055485	1.263491E-02	-37.968559	1.238279E-02	-38.143627
238	1.225601E-02	-38.233021	1.238279E-02	-38.143627	1.212874E-02	-38.323689
239	1.200099E-02	-38.415661	1.212874E-02	-38.323689	1.187275E-02	-38.508972
240	1.174403E-02	-38.603657	1.187275E-02	-38.508972	1.161482E-02	-38.699745
241	1.148514E-02	-38.797279	1.161482E-02	-38.699745	1.135496E-02	-38.896286
242	1.122431E-02	-38.996811	1.135496E-02	-38.896286	1.109316E-02	-39.098892
243	1.096154E-02	-39.202572	1.109316E-02	-39.098892	1.082943E-02	-39.307888
244	1.069683E-02	-39.414894	1.082943E-02	-39.307888	1.056375E-02	-39.523636
245	1.043019E-02	-39.634155	1.056375E-02	-39.523636	1.029615E-02	-39.746506
246	1.016162E-02	-39.860744	1.029615E-02	-39.746506	1.002660E-02	-39.976925
247	9.891102E-03	-40.095108	1.002660E-02	-39.976925	9.755120E-03	-40.215347
248	9.618653E-03	-40.337715	9.755120E-03	-40.215347	9.481702E-03	-40.462273
249	9.344266E-03	-40.589096	9.481702E-03	-40.462273	9.206345E-03	-40.718254
250	9.067941E-03	-40.849827	9.206345E-03	-40.718254	8.929055E-03	-40.983891
251	8.789683E-03	-41.120537	8.929055E-03	-40.983891	8.649827E-03	-41.259853
252	8.509486E-03	-41.401932	8.649827E-03	-41.259853	8.368663E-03	-41.546879
253	8.227353E-03	-41.694798	8.368663E-03	-41.546879	8.085561E-03	-41.845798
254	7.942620E-03	-42.000000	8.085561E-03	-41.845798	7.942620E-03	-42.000000

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